UNITED STATES DEPARTMENT OF
COMMERCE
NEWS
WASHINGTON, D.C. 20230

NATIONAL
OCEANIC AND
ATMOSPHERIC
ADMINISTRATION

CONTACT: Maureen O'Leary
(202) 482-6047

NOAA 00-020
EMBARGOED UNTIL
MARCH 23, 2000, 2 p.m.

WORLD OCEAN HAS WARMED SIGNIFICANTLY OVER PAST 40 YEARS

Scientists at NOAA have discovered that the world ocean has warmed significantly during the past 40 years, the Commerce Department announced today. The largest warming has occurred in the upper 300 meters of the world ocean on average by 0.56 degrees Fahrenheit. The water in the upper 3000 meters of the world ocean warmed on average by 0.11 degrees Fahrenheit. These findings represent the first time scientists have quantified temperature changes in all of the world's oceans from the surface to 3000 meters depth.

"In each ocean basin substantial temperature changes are occurring at much deeper depths than we previously thought. This is just one more piece of the puzzle to understanding the variability of the earth's climate system," said NOAA Administrator D. James Baker. "Since the 1970's, temperatures at the earth's surface have warmed, Arctic sea ice has decreased in thickness, and now we know that the average temperature of the world's oceans has increased during this same time period."

The scientists determined their findings by using data -- 5.1 million temperature profiles -- from sources around the world, to quantify the variability of the heat content (mean temperature) of the world ocean from the surface through 3000 meter depth for the period 1948 to 1996. Three major ocean basins were examined; Atlantic, Indian and Pacific.

The Pacific and Atlantic Oceans have been warming since the 1950s; the Indian Ocean has warmed since the 1960s. The warming patterns of the Pacific and Indian Oceans are similar which suggests that the same phenomena is causing the changes to occur in both oceans.

The world ocean warming is likely due to a combination of natural variability, such as the Pacific Decadal Oscillation, and human-induced effects, say the scientists who calculated the warming. The scientists, led by Sydney Levitus, who heads NOAA's Ocean Climate Laboratory in Silver Spring, Md., report their findings in the March 24 issue of *Science* magazine in an article titled "Warming of the World Ocean." They found that there is a consistent warming signal in each ocean basin.

Together the ocean and atmosphere interact in complex ways to produce what we know as climate. Owing to its large mass, the ocean acts as the "memory" of the earth's climate system and can store heat for significant periods, decades or longer. As a result, it might become possible some day for scientists to use ocean temperature measurements to forecast the earth's climate decades in advance.

"It is possible that ocean heat content may be an early indicator of the warming of surface, air and sea surface temperatures more than a decade in advance," said Levitus. "For example, we found that the increase in subsurface ocean temperatures preceded the observed warming of surface air and sea surface temperatures, which began in the 1970's.

"Our results support climate modeling predictions that show increasing atmospheric greenhouse gases will have a relatively large warming influence on the earth's atmosphere. One criticism of the models is that they predict more warming of the atmosphere than has been actually observed. Climate modelers have suggested that this 'missing warming' was probably to be found in the world ocean. The results of our study lend credence to this scenario."

The reported results were made possible in part by an international ocean data management project headed by Levitus that has resulted in the addition of more than two million historical temperature profiles to electronic archives during the past seven years. Levitus stated that "international cooperation in building the global ocean databases required for understanding the role of the ocean as part of the earth's climate system has been excellent. Contributions of subsurface ocean temperature data have come from all countries that make oceanographic measurements. Substantial contributions of data have come from the United States, Russia, the United Kingdom, Germany, France, Canada, Australia, and Japan." Nearly all of the data were gathered by either research ships, naval ships, buoys, or merchant ships. Some merchant ships deploy instruments that measure the temperature of the upper ocean as participants in voluntary ship-of-opportunity programs. Understanding the role of the ocean in climate change and making decadal climate forecasts will be greatly enhanced by observations planned as part of an international Global Ocean Observing System.